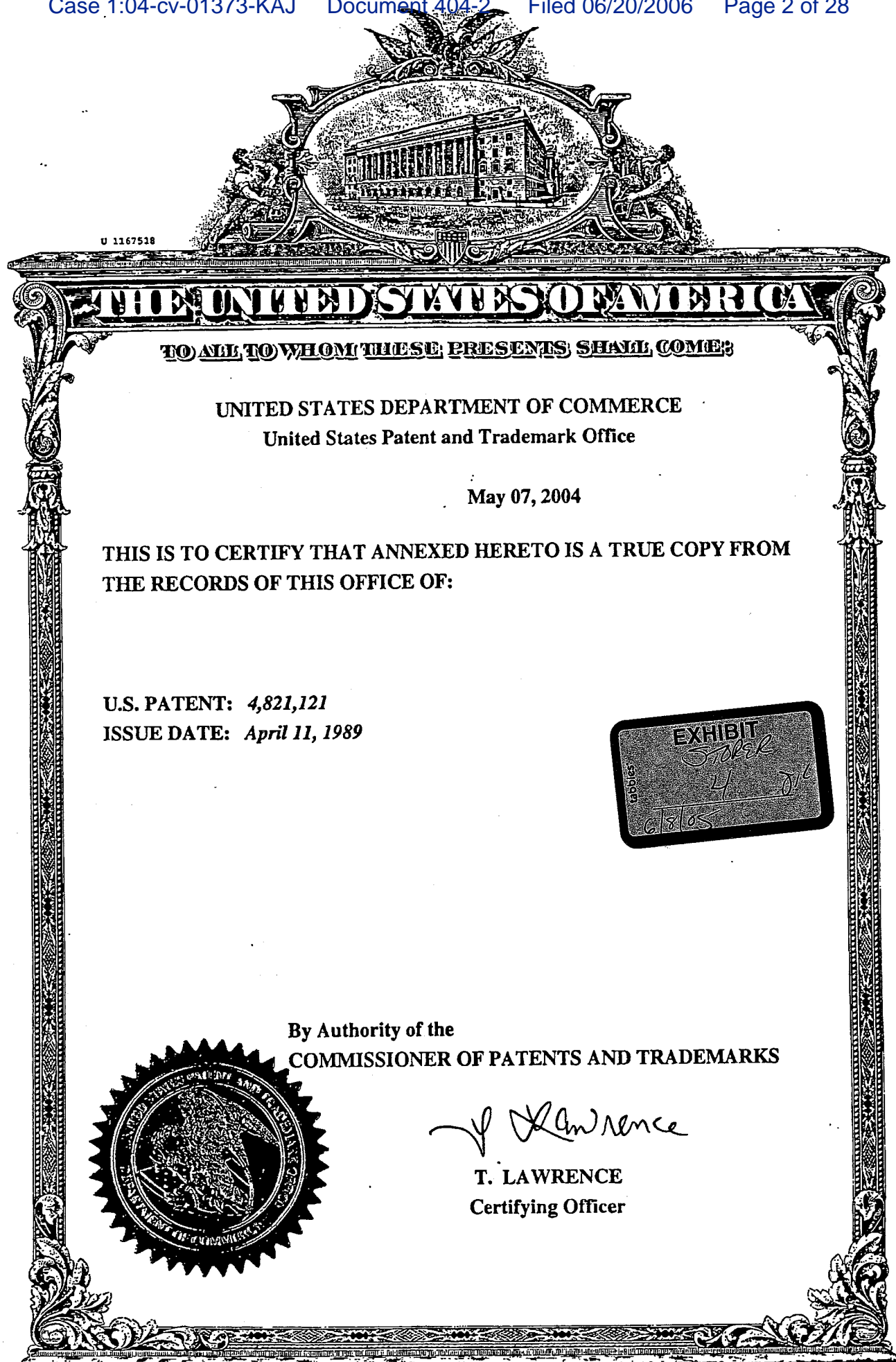


EXHIBIT 1



United States Patent [19]

Beaulier

[11] Patent Number: 4,821,121

[45] Date of Patent: Apr. 11, 1989

[54] ELECTRONIC STILL STORE WITH HIGH SPEED SORTING AND METHOD OF OPERATION

[75] Inventor: Daniel A. Beaulier, Menlo Park, Calif.

[73] Assignee: Ampex Corporation, Redwood City, Calif.

[21] Appl. No.: 18,786

[22] Filed: Feb. 24, 1987

Related U.S. Application Data

[63] Continuation of Ser. No. 740,297, May 31, 1985, abandoned, which is a continuation of Ser. No. 483,327, Apr. 8, 1983, abandoned.

[51] Int. Cl.⁴ H04N 5/14

[52] U.S. Cl. 358/160; 358/183

[58] Field of Search 358/160, 183, 311, 342, 358/102; 360/35.1, 9.1, 10.1, 14.1

[56] References Cited

U.S. PATENT DOCUMENTS

4,152,722 5/1979 Inuiya et al. 358/102
 4,172,264 10/1979 Taylor et al. 358/185
 4,302,776 11/1981 Taylor et al. 358/160

FOREIGN PATENT DOCUMENTS

0051305 5/1982 European Pat. Off. 360/14.1

OTHER PUBLICATIONS

Hugh Boyd, "The DLS6000—A New Digital Still Store Library System", International Broadcast Engineer, vol. 11, No. 170, pp. 46-48.

Primary Examiner—Edward L. Coles, Sr.

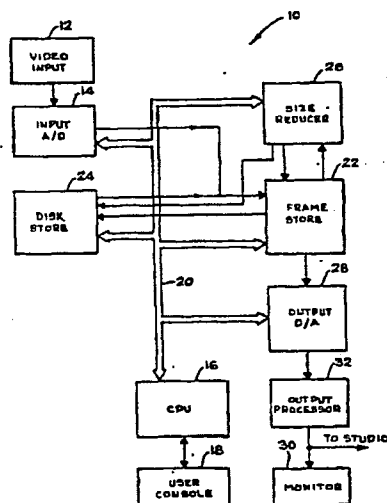
Assistant Examiner—David E. Harvey

Attorney, Agent, or Firm—Bradley A. Perkins; Ronald C. Fish; George B. Almeida

[57] ABSTRACT

An electronic still store system stores and selectively outputs video image data defining a plurality of signal frame still images. The simultaneous display of up to 16 or more quarter sized images for scanning or sorting by an operator is facilitated by generating a quarter sized copy of each newly received image frame and storing both together on a conventional magnetic disk storage device as is typically employed in general purpose digital computing systems. The quarter sized image can then be recalled directly for a multi-image scan or sort function in which 16 reduced size images are displayed simultaneously without the time delays associated with the retrieval and size reduction of 16 full size images.

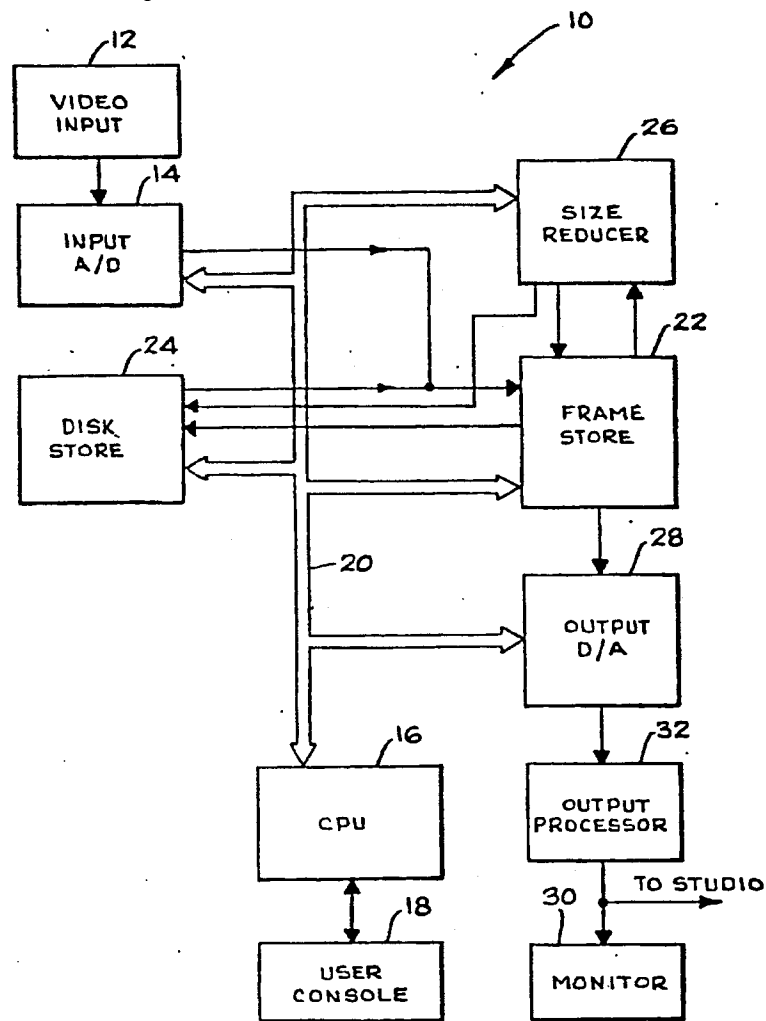
15 Claims, 1 Drawing Sheet



U.S. Patent

Apr. 11, 1989

4,821,121



4,821,121

1

ELECTRONIC STILL STORE WITH HIGH SPEED SORTING AND METHOD OF OPERATION

This is a continuation of application Ser. No. 740,297, 5
filed on May 31, 1985, now abandoned, which is a con-
tinuation of application Ser. No. 483,327, filed Apr. 8,
1983, now abandoned.

BACKGROUND OF THE INVENTION

This invention relates to a digital electronic still store 10
for broadcast television signals and more particularly to
a still store providing a high speed multiimage scan or
sort capability.

Digital electronic still store video display systems 15
store a plurality of frames of video images on relatively
low cost magnetic disk storage. Any selected one of the
stored image frames may then be communicated to a
frame store from which data defining the image is repet-
itively read out to generate a continuously displayed 20
television image. The still store image can then be com-
bined with a second image to create a combined video
image. For example, it is common to insert a selected
still store image depicting a news event in the upper left
hand corner of a live studio image depicting a news- 25
caster describing the news event.

The disk store is capable of storing a large library of
single frame images and it is often desirable to generate
a reduced size multiple image picture for editing or
other purposes. For example, it might be desirable to 30
create a special effect with multiple images or an editor
may wish to view and compare several images at the
same time for the purpose of selecting those images
which will be used in a television broadcast. However,
each of the several images which are to be simulta- 35
neously displayed must first be read from the disk store
as full size images and then reduced for insertion into
the multi-image display. This process takes $\frac{1}{2}$ to $\frac{1}{3}$ sec-
ond for each image and results in a delay of several
seconds for the composite multi-image display. Such a 40
time delay is at best disconcerting for a busy editor and
precludes use of the editing features of the system dur-
ing a real time broadcast.

U.S. Pat. No. 4,172,264, "Control Arrangement for
Video Synchronizers", to Taylor et al describes an 45
arrangement in which joysticks may be used to selec-
tively position video images on a television display. The
system requires full sized images to be accessed and
then reduced in size as described above.

U.S. Pat. No. 4,302,776, "Digital Still Picture Storage 50
System With Size Change Facility", to Taylor et al
discloses a still store system in which multiple images
may be accessed and reduced in size for simultaneous
display as discussed above. The suggestion is made that
an array of reduced size images be stored as a single 55
image frame. This has the effect of eliminating the time
required to reproduce the array but precludes the flexi-
bility of choosing or repositioning any desired images
when recalling the array. Furthermore, the aforemen-
tioned time delays are encountered when assembling 60
the original multi-image display.

SUMMARY OF THE INVENTION

An electronic still store system in accordance with
the invention rapidly generates and outputs for display 65
to an operator a still image frame comprising a plurality
of selectively positioned, reduce size images which may
be simultaneously viewed for scanning or editing pur-

2

poses. The system includes an image store for storing
therein a plurality of frames of video images with both
a full spatial resolution copy for full size video output
and a reduced spatial resolution copy for reduced size
video output of each image being stored, and a frame
store which is operable in a first mode to receive from
the image store, store and repetitively generate a full
spatial resolution output image frame. The frame store
is operable in a second mode to receive from the image
store and store a plurality of reduced spatial resolution
image frames. The frame store is further operable in the
second mode to repetitively generate an output image
frame having an image from each of the plurality of
reduced spatial resolution image frames selectively lo-
cated at a different position within the output image
frame.

The system may further include an image size re-
ducer coupled to produce a quarter size reduced spatial
resolution image in response to a full resolution image
stored by the frame store, a video input, an analog-to-
digital converter coupling the video input to the frame
store, a monitor for viewing output video images and an
output digital-to-analog converter coupled to convert
the output video images from a digital form to an analog
form for use by the monitor. A central processing unit is
connected to receive user commands through a user
console and to control the other devices of the system in
response thereto.

The image store employed herein is a general purpose
magnetic disk storage system as is currently used in
general purpose digital computer systems.

In operation the system can rapidly assemble an array
of 16 reduced size images for output as a single image
frame. A system operator may view the reduced size
images simultaneously for rapid scanning of some or all
of the stored images within the image store, which is
preferably a magnetic disk. Because the images are read
from the image store in reduced size and spatial resolu- 35
tion, the output image formation time is approximately
the $\frac{1}{2}$ to $\frac{1}{3}$ second required to transfer a single full size
image instead of the several seconds which would be
required to transfer 16 full size images prior to resolu-
tion reduction and storage as a reduced size image.

Using this system an operator may rapidly scan many
still frame images which are stored by the image store
or may compile lists of randomly selected image frames
for simultaneous viewing as an array of reduced size
images. Because of the rapid response rate the system
becomes feasible for development and outputting of
data frames containing multiple reduced size images on
demand during a television broadcast.

BRIEF DESCRIPTION OF THE DRAWING

A better understanding of the invention may be had
from a consideration of the following detailed descrip-
tion taken in conjunction with the accompanying draw-
ing in which the sole FIGURE is a block diagram rep-
resentation of an electronic still store system in accor-
dance with the invention.

DETAILED DESCRIPTION

Referring now to the sole FIGURE, a digital elec-
tronic still store system 10 for rapidly assembling as a
single image frame an array of reduced size images is
shown as including a video input circuit 12. The video
input circuit 12 may be another electronic still store
system, a TV camera, or some other source of video
data from which one or more frames of a video image

4,821,121

3

may be captured. In the preferred embodiment of the electronic still store system 10, the video signal is processed in component form. A method and apparatus for producing the component information which may be employed is more fully disclosed in the U.S. Pat. No. 4,675,876, issued Sept. 22, 1987 to D. Beaulier, which is assigned to the same assignee as this application, which is incorporated by reference herein. Therefore, the video input 12 will include appropriate video signal decoding means to process video data received from sources that provide the data in an encoded form.

An input analog-to-digital (A-D) converter 14 is coupled to receive an input video signal provided by the video input circuit 12, which typically includes video signal processing circuitry that prepares the signal for conversion by the A-D converter 14. The A-D converter 14 converts the input video signal to a digital form which is suitable for handling and processing by digital circuitry. The input AD 14 receives the video signal from the video input 12 and converts the video signal to the digital sampled data form in which each pixel of video data is represented by three eight bit data bytes defining respectively luminance, red chrominance and blue chrominance components. Conventionally, the chrominance data has half the spatial resolution of the luminance data in the horizontal dimension so that data is produced in a repetitive 4 byte luminance/chrominance component sequence of L1, CR1, CB1, L2—L3, CR3, CB3, L4 and so forth. The single byte representation affords a high dynamic resolution of 256 distinguishable states for each color component. For adequate dynamic resolution, each video component at a sampled data point is preferably defined by at least 6 binary bits providing 64 distinguishable intensities. A central processing unit (CPU) 16 formed from a Z80 microprocessor is connected to receive operator commands from a user console 18. CPU 16 is connected for bidirectional communication of commands and other data over a system bus 20. The system bus 20 is connected to input A-D 14 as well as other major components of the still store system 10 to carry the address, mode select and status information required to control the operation of the still store system 10.

A frame store 22 which in the preferred embodiment is a random access memory, is coupled to receive mode control information from CPU 16 over system bus 20 and to receive video data representing a frame of a video image from either input A-D 14 or from a multiple frame image store implemented as a magnetic disk drive store 24 in the preferred embodiment but which can be any bulk storage memory device in other embodiments. Frame store 22 is a random access store that is capable of storing more data than is required for a single video image frame.

The storage capacity provided by presently available 64K memory chips enables storing up to 750 lines of video data. In any event, out of a 525 line NTSC frame of data only about 484 lines represent video data. Because of the two dimensional nature of a video image a quarter size image defined by video data having one-fourth the spatial resolution of a full size image requires one-sixteenth the storage capacity of a full size, full spatial resolution image. A quarter resolution image thus requires the equivalent storage of 30 lines of a full resolution image. In any event the frame store 22 either contains initially or is expanded to contain, storage of video data representing a full resolution full size image, as well as a quarter resolution copy thereof.

4

A size reducer 26 is connected to be controlled by data from CPU 16 received over the system bus 20. Size reducer 26 is operable to receive video data from frame store 22 to convert the video data to a quarter spatial resolution copy thereof, and communicate the quarter resolution copy back to frame store 22 for storage therein. In a similar fashion, when video data received from disk store 24 does not contain a corresponding quarter spatial resolution copy, size reducer 26 may be employed to generate a quarter spatial resolution copy for subsequent transfer to either frame store 22 or disk store 24. Hence, any time frame store 22 receives a video image frame that does not have a corresponding quarter resolution copy, the size reducer 26 may be used to make such a copy.

As a new frame of video data is transferred from frame store 22 to disk store 24 for more permanent storage, both the full resolution and the quarter resolution copy are transferred. Since the quarter resolution copy is represented by only one-sixteenth the data of a full resolution copy, the communication and storage of the quarter resolution copy imposes only a small burden on both system operating time and extra storage space requirement within disk store 24. It should be noted that disk store 24 is a general purpose magnetic disk storage device as is commonly used in connection with general purpose digital computing systems.

During system 10 operation frame store 22 repetitively accesses stored video data to generate a continuous stream of output video data frames representing the stored image. An output digital-to-analog converter 28 receives this digital output data and converts it to an analog video signal which is subsequently supplied to output processor 32. Output processor 32 is a conventional video signal output processor, for forming a television signal in a standard format, which can be used to drive a monitor 30 for viewing of the output video image by a system monitor. The analog video signal form may also be communicated to studio equipment for further use, broadcasting or storage.

When operating in a first, normal broadcast mode, frame store 22 receives a full resolution frame of video data from disk store 24 and outputs a continuous television image in digital data form in response thereto.

In a second, editing or browsing mode, CPU 16 commands disk store 24 to output reduced resolution image data which is selectively positioned in frame store 22 for viewing in one of 16 reduced size image positions in a 4x4 array as a mosaic which fits within a normal full size image. Under operator control, the 16 viewable images may be taken sequentially from disk store 24 starting with a selected image frame. This mode is useful when scanning all of the images stored by disk store 24. Alternatively, the 16 images may be taken randomly from a list of stored images developed by the operator. This mode is especially useful when it is desired to compare certain images.

The 16 image assembly time is greatly reduced because only an amount of data equivalent to one full size, full spatial resolution, image need be transferred from disk store 24 to define all 16 images. This is only one-sixteenth of the time that would conventionally be required.

While there has been shown and described above, a particular arrangement of an electronic still store system which can rapidly compose a multiple image frame of data, for the purpose of enabling a person skilled in the art to make and use the invention, it will be appreciated

5

4,821,121

ated that the invention is not limited thereto. Accordingly, any modifications, variations or equivalent arrangements within the scope of the attached claims should be considered to be within the scope of the invention.

What is claimed is:

1. An electronic still store system comprising:
an image store means for retrievably storing therein a plurality of image frame copies of video frames, the image frame copies comprising data representing full spatial resolution images and corresponding data representing reduced spatial resolution images of the video frames;
frame store means for receiving and storing in a first mode one of said full spatial resolution images from said image store means and for repetitively generating a full spatial resolution image output, and in a second mode for receiving from the image store means and storing a plurality of said reduced spatial resolution images each at selectively located different positions, the frame store means in the second mode further repetitively generating an image output comprising the stored plurality of said reduced spatial resolution images; and
size reducer means for receiving from the frame store means the stored full spatial resolution image and in response thereto returning to the frame store means a corresponding reduced spatial resolution image, wherein the frame store means receives and stores the returned reduced spatial resolution image while continuing to store the stored full spatial resolution image.
2. The electronic still store system according to claim 1, wherein the reduced spatial resolution images each have a spatial resolution of one-fourth the spatial resolution of the corresponding full spatial resolution image.
3. The electronic still store system according to claim 1, wherein said frame store means includes a central processing unit, controlled by an operator in said first mode for selecting which of said full spatial resolution images stored in said image store means is to be retrieved from the image store means, and in said second mode for selecting which of said reduced spatial resolution images stored in said image store means are to be retrieved and stored in said frame store means, and further for selecting the different positions within a video frame at which each of said retrieved reduced spatial resolution images is stored.
4. The electronic still store system according to claim 3, wherein said frame store means further comprises an output digital-to-analog converter coupled to receive output image data from the frame store means and in response thereto to generate an analog video signal representing an output image; and
a monitor coupled to receive the analog video signal and display the output image represented thereby.
5. The electronic still store system according to claim 4, further comprising a video input means for generating an input analog video signal representing an input video image and an analog-to-digital converter coupled between the video input means and the frame store means for converting the input analog video signal to a digital form such that digital data representing said input video image is received and stored by the frame store means.
6. A video still store system comprising:
external source means for supplying a full size image data set representing a full size image frame;

6

- a size reducer coupled to receive the full size image data set for producing therefrom a reduced size image data set representing a corresponding reduced size image frame;
- an image store for storing a plurality of full size image data sets representing a plurality of full size image frames and for storing a plurality of reduced size image data sets representing a plurality of reduced size image frames, each of said reduced size image data sets corresponding to one of said full size image data sets; and
frame store means for storing one of said full size image data sets from either the external source or said image store, wherein if said image store does not supply a corresponding reduced size image data set, said frame store outputs a copy of said full size image data set to said size reducer, and receives in turn a corresponding reduced size image data set;
wherein said image store stores the reduced size image data set along with the previously stored corresponding full size image data set.
7. An apparatus for storing video pixel data representing video images of a first resolution and, for each each of the images at said first resolution, a corresponding video image at a second resolution, comprising:
random access memory means for storing video pixel data representing one of a succession of full size images at said first resolution and a corresponding reduced size version thereof at said second resolution;
bulk memory means for receiving said video pixel data from said random access memory means and for storing said succession of full size images and the corresponding reduced size versions thereof, and for outputting upon a user's command, either a selected one of the successive full size images or selected ones of the corresponding reduced size versions thereof for direct transfer to, and storage back in, said random access memory means; and
means responsive to said random access memory means for selectively generating one of said corresponding reduced size versions from the respective full size image in said random access memory means, and for transferring the video pixel data representing and the corresponding reduced size version back to the contents of said random access memory means.
8. An apparatus for storing video pixel data as at least one full size image at a first resolution, and at least one reduced size image thereof at a second lower resolution, comprising:
random access memory means having an input port and an output port, for storing the video pixel data presented at the input port;
said video pixel data representing the full size video image at a first resolution being stored in a first group of memory locations in said random access memory means;
bulk storage memory for also storing the video pixel data and for presenting selected groups of video data at said input port for storage by said random access memory means;
size reducing means responsive to said random access memory means for directly receiving said video pixel data stored in said random access memory means representing said full size image at said first resolution, and for reducing said image to the re-

4,821,121

7

duced size image at the second lower resolution, and for supplying said reduced size image at said second resolution directly back to said random access memory means in a second group of memory locations therein;

control means, coupled to said random access memory means, to said bulk storage memory and to said size reducing means, for causing said size reducing means to generate said reduced size image at said second resolution and to supply same to said random access memory means in said second group of memory locations; and

said control means further causing the transfer of the full size and reduced size video pixel data from said random access memory means to said bulk storage memory for storage, and for causing the selective transfer from said bulk storage memory directly into said random access memory means of either said full size image at said first resolution or said reduced size image at said second lower resolution.

9. The apparatus of claim 8 wherein said size reducing means produces said reduced size image at said second resolution with one fourth the spatial resolution of said full size image at said first resolution, and wherein said control means determines the transfer of said reduced size image at said second resolution into said random access memory means for storage at a selected one of 16 predetermined groups of said memory locations.

10. A system for storing video data representing video images which are displayable as rasters of vertically distributed horizontal lines, each represented video image normally occupying a raster of selected vertical and horizontal size, the system comprising:

a video image size reducer having an input for receiving video data representing a video image corresponding to the selected raster size and for generating video data representing a reproduction of said video image at a selected fractional-size of said selected raster size;

a first store for receiving video data for storage and for providing video data therefrom, said first store having a capacity for storing the video data representing the video image corresponding to the selected raster size simultaneously together with the video data supplied by said video image size reducer representing said reproduction of the video image at the selected fractional-size;

a second store for receiving and storing the video data stored in the first store and for providing video data therefrom directly to the first store, said second store further storing video data representing a plurality of additional video images each corresponding to the selected raster size, and video data representing a plurality of additional reproductions at the selected fractional size of said selected raster size; and

means for selectively transferring from said second store directly to said first store either video data representing of the plurality of video images corresponding to the selected raster size, or video data representing a plurality of reproductions at the selected fractional-size of said selected raster size.

11. A method of storing video pixel data comprising: receiving and storing in selected storage locations in a random access memory, full video pixel data comprising a full size image;

8

generating from the full video pixel data, reduced video pixel data representing a reproduction thereof in the form of a reduced size image at a lower resolution;

storing the reduced video pixel data representing the reduced size image in additional storage locations in said random access memory along with the full video pixel data;

storing both the full size image and the reduced size image in bulk storage memory; and

selectively transferring either the full size image or the reduced size image from said bulk storage memory into said random access memory for further processing.

12. A video still store system comprising:

an external source for supplying a plurality of full size image data sets representative of corresponding full size images;

an image store for storing said full size image data sets, and for storing a like plurality of reduced size image data sets representing a plurality of reduced size images, each of said reduced size image data sets corresponding to one of the full size image data sets;

a memory for simultaneous storage of one of said full size image data sets and a corresponding one of said reduced size image data sets;

a size reducer means for receiving from said memory the stored one of said full size image data sets, and for producing and returning to said memory the corresponding one of said reduced size image data sets;

said memory being responsive to either the external source or the image store for storing said one of said full size image data sets, and for supplying to the image store both the stored one of said full size image data sets and the corresponding one of said reduced size image data sets;

said memory being responsive to the image store to store at different selected locations the plurality of reduced size image data sets;

said memory further supplying as an output image either the plurality of reduced size image data sets arranged at different locations within the output image, or the full size image data set; and

means responsive to said memory for displaying the output image as a raster scanned video display.

13. A method of storing video pixel data for access and display comprising:

providing data sets for a plurality of full size images at a first spatial resolution;

generating, from the data sets of the full size images, second data sets representing a corresponding plurality of reduced size reproduction images at a second lower spatial resolution;

storing both the data sets of the plurality of full size images and the data sets of the corresponding plurality of reduced size reproduction images in respective selected groups of storage location; and

selectively accessing from the storage locations a data set representing one of the plurality of full size images, and a data set representing one of the corresponding plurality of the reduced size reproduction images, simultaneously.

14. An apparatus for storing video pixel data as at least one full size image at a first resolution, and at least one reduced size image thereof at a second lower resolution, comprising:

4,821,121

9

random access memory means having an input port and an output port, for storing the video pixel data presented at the input port;
 said video pixel data representing the full size video image at a first resolution being stored in a first group of memory locations in said random access memory means;
 bulk storage memory for also storing the video pixel data and for presenting selected groups of video data at said input port for storage by said random access memory means;
 size reducing means responsive to said random access memory means for receiving said video pixel data stored in said random access memory means representing said full size image at said first resolution, and for producing reduced size pixel data representing the reduced size image at the second lower resolution, and for supplying said reduced size image at said second resolution to said random access memory means in a second group of memory locations therein;
 control means coupled to said random access memory means, to said bulk storage memory and to said size reducing means, for causing said size reducing means to generate said reduced size image at said second resolution and to supply said reduced image to said random access memory means in said second group of memory locations;
 said control means further causing the transfer of the full size and reduced size video pixel data from said random access memory means to said bulk storage memory for storage, and for causing the selective transfer from said bulk storage memory into said random access memory means of either said full

10

size image at said first resolution or said reduced size image at said second lower resolution; and wherein said control means also determines the selective transfer of said reduced size image at said second resolution from said size reducing means into said bulk storage memory via the random access memory means.

15. A method of storing video pixel data for access and display comprising:
 providing data sets for a plurality of full size image at a first spatial resolution, wherein each one of the full size images occupies upon display a raster of selected vertical and horizontal size;
 generating, from the data sets of the full size images, second data sets representing a corresponding plurality of reduced size reproduction images at a second lower spatial resolution;
 storing both the data sets of the plurality of full size images and the data sets of the corresponding plurality of reduced size reproduction images in respective selected groups of storage locations;
 selectively accessing from the storage locations a data set of one of the plurality of full size images, and one of the sets of the corresponding plurality of the reduced size reproduction images simultaneously;
 wherein the step of accessing further includes, retrieving a plurality of reproduction images, storing the retrieved plurality of images in a random access memory, and outputting the stored plurality of retrieved images as a mosaic of reproduction images occupying a raster of the selected vertical and horizontal size.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : 4,821,121
DATED : April 11, 1989
INVENTOR(S) : Daniel A. Beaulier

Page 1 of 1

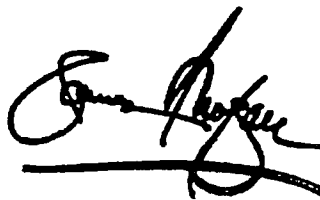
It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Column 6,
Line 46, please delete "and"

Column 8,
Line 61, please delete " ,"

Signed and Sealed this

Fourth Day of March, 2003

A handwritten signature in black ink, appearing to read "James E. Rogan", with a horizontal line drawn underneath it.

JAMES E. ROGAN
Director of the United States Patent and Trademark Office

EXHIBIT 2

AMPEX Corporation

 Home | Contact Us | Product
Corporate Background

Ampex Corporation has been at the forefront of technology breakthroughs for more than five decades. Among Ampex's many contributions are the development of the first practical videotape recorder, the introduction of helical scan recording and the invention of slow motion instant replay.


 Ampex Data Systems

Investor Information

Corporate Background

Ampex Chronology

Emmy Awards

Monitor Awards

Management

Ampex Chronology

- 1944** Ampex Electric and Manufacturing Company is formed by Alexander M. Poniatoff in San Carlos, California.
- 1948** American Broadcasting Company uses an Ampex Model 200 audio recorder for the first-ever U.S. tape delay radio broadcast of The Bing Crosby Show.
- 1950** Ampex introduces the first "dedicated" instrumentation recorder, Model 500, built for the U.S. Navy.
- 1954** Ampex introduces the first multi-track audio recorder derived from multi-track data recording technology.
- 1954** Ampex introduces the first magnetic theater sound system, made for Todd/AO CinemaScope.
- 1956** The Ampex VRX-1000 (later renamed the Mark IV) videotape recorder is introduced on March 14, 1956, at the National Association of Radio and Television Broadcasters in Chicago. This is the world's first practical videotape recorder and is hailed as a major technological breakthrough. CBS goes on air with the first videotape delayed broadcast, Douglas Edwards and The News, on November 30, 1956, from Los Angeles, California, using the Ampex Mark IV.

In 2005, the six inventors of the first practical videotape recorder were honored with the first-ever Lifetime Achievement Award from the National Academy of Television Arts and Sciences. They were Charles Anderson, Ray Dolby, Charles Ginsburg, Shelby Henderson, Alex Maxey, and Fred Pfost.

- 1958** NASA selects Ampex data recorders and magnetic tape, used for virtually all U.S. space missions since.
- 1959** The famous Nixon-Khrushchev "Kitchen Debate" takes place at the Moscow Trade Fair, and is captured on an Ampex

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videotape recorder.

- 1960 The Academy of Motion Picture Arts and Sciences presents Ampex with an Oscar for technical achievement.
- 1961 Helical scanning recording is invented by Ampex, the technology behind the worldwide consumer video revolution, and used in all home VCRs today.
- 1963 Ampex introduces EDITREC electronic video editing, allowing broadcast television editors frame-by-frame recording control simplifying tape editing and making animation effects possible. This was the basis for all subsequent editing systems.
- 1963 Ampex introduces a new computer peripheral digital tape transport, the TM-7. Its design far surpasses previous tape drives, using 80 percent fewer parts and completely eliminating pinch rollers and brake cylinders.
- 1964 Ampex introduces the VR-2000 high-band videotape recorder, the first ever to be capable of the color fidelity required for high-quality color broadcasting.
- 1967 ABC uses the Ampex HS-100 disk recorder for playback of slow-motion downhill skiing on World Series of Skiing in Vail, Colorado. Thus begins the use of slow motion instant replay in sporting events.
- 1967 Ampex introduces the RG memory. It is a medium capacity memory with an access time of 350 nanoseconds (less than half of one millionth of a second) and expandable from medium to very large capacity (up to 5,000,000 bits) by adding memory modules.
- 1967 The introduction of the Ampex VR-3000 revolutionizes video recording.
- 1968 Ampex invents magneto-resistive (MR) heads, now used in advanced computer disk drives.
- 1969 Ampex introduces the Videofile® system, used by Scotland Yard for the electronic storage and retrieval of fingerprints.
- 1970 Ampex introduces the ACR-25, the first automated robotic library system for the recording and playback of television commercials.
- 1970 Ampex introduces TBM (TeraBit Memory), a 2-inch transverse tape-based online digital storage system for high-performance computing applications.
- 1972 The first TBM delivered reaches a never-before-achieved 3 trillion-bit capacity.
- 1974 Ampex introduces the AVR-2, the first modular quadruplex recorder/reproducer for professional broadcasters. It requires one-half to one-third the operating space required by other quad machines.
- 1976 Ampex introduces the VPR-1, helical scan, 1-inch videotape recorder. The VPR-1's successor, the Type C VPR-2 (1978), becomes the industry standard for video recording.

AXD036810

- 1977 Ampex introduces the AST® process, the first automated sca tracking for variable speed effects, making slow motion possible directly from tape for the first time.
- 1977 Ampex introduces Electronic Still Store (ESS™) which allow producers to store digital video images for later editing and broadcast.
- 1977 Ampex introduces the HBR-3000, the first high-bit rate, high-density magnetic recorder for logging and storage of electromagnetic data.
- 1978 The Ampex Video Art (AVA™) video graphics system is use by artist Leroy Nieman on air during Super Bowl XII. AVA, the first video paint system, allows the graphic artist, using an electronic pen, to illustrate in a new medium, video. This innovation paved the way for today's high quality electronic graphics, such as those used in video games.
- 1981 Ampex introduces the ADO® system, which creates digital special effects, allowing rotation and perspective of video images. This changed forever the way television material would be manipulated and created.
- 1983 Ampex introduces the DCRS digital cassette recorder, offerin compact cassette storage with the equivalent of 16 digital, 14 inch, 8 DDR instrumentation reels on one cassette.
- 1983 Partial-response maximum-likelihood (PRML) data decoding technology has its first use in Ampex's DCRsi™ recorders. This technology is now commonly used in high performance computer disk drives and other high density magnetic data storage devices.
- 1988 Ampex introduces D-2, the first composite digital video recording format.
- 1991 Ampex obtains patent for keepered media, which adds a soft magnetic layer to magnetic recording media, increasing the resulting recording capacity.
- 1992 Ampex introduces its DCT® products, the first digital component post-production system using digital image compression technology to produce unsurpassed quality images. The system includes the finest videotape recorder ever made, the DCT 1700d.
- 1992 Ampex introduces its DST® products, high-performance computer mass data storage systems able to store half the contents of the Library of Congress in 21 square feet of floor space.
- 1995 Ampex introduces the DIST™ 120i and DIS 160i dual port, data/instrumentation recorders, making it possible for the first time to capture real time instrumentation data and then utilize the same recorder to process the data in a computer environment through its second port using SCSI-2 protocol.
- 1996 Ampex introduces the new double density DST data storage product line, offering the highest capacity data storage system

in the industry. The DST 812 robotic library can now store 12.8 terabytes of data, the entire Library of Congress, in 21 square feet of floor space.

- 1997** Ampex introduces the DST 712 Automated Cartridge Library System capable of storing up to 5.8 terabytes with an aggregate data transfer rate of up to 40MB/sec.
- 1998** Fox Television Network becomes the first network to store its primetime television programs as data files on DST media and library systems.
- 1999** Ampex Introduces scalability to the DST 712 library system, allowing multiple DST 712 cabinets to be connected via a simple cartridge pass through mechanism. Multiple libraries can be configured for almost unlimited capacity.

Emmy Awards

- 1957** VTR development
- 1967** VR-2000 color VTR
- 1978** AST® Video Tracking
- 1978** Type C format development
- 1981** ESS™ Still Store
- 1983** ADO® Digital Effects System
- 1984** VPR-5 (first helical scan portable VTR)
- 1986** Zeus™ Advanced Video Processor
- 1986** VPR-3 Videotape Recorder
- 1989** D-2 video recording technology development
- 1990** ACR 225 Commercial Spot Player
- 2005** Color Slow Motion and Instant Replay

Monitor Awards

Presented by the International Teleproduction Society for outstanding technical achievement

- 1983** ADO® Digital Effects System
- 1985** VPR-5 Portable Videotape Recorder
- 1987** Zeus™ Advanced Video Processor
- 1994** DCT 700d Digital Tape Drive

"Emmy®" is a registered trademark and service mark of
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EXHIBIT 3



Steve Denning
The website for business and
organizational storytelling

Organizational and business storytelling:
story #37
Kodak tries to convince Wall Street of its
story through job cuts

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Organizational and Business Storytelling In The News: Story #37

January 24, 2004:

Kodak announces staff cuts of up to 21%

Why do big companies, with all the smartest, sharpest people in the world on their staff, fail to spot glaringly obvious market trends? Why did it take *A&P* so long to figure out that people wanted upscale products in the supermarket? Why did it take *Digital Equipment Corporation* to realize that the PC was a threat to its minicomputer business? Why did it take *Motorola* so long to realize that the future of mobile phones was digital technology, when Motorola itself had invented much of the technology? Yesterday, the lead story in both the Wall Street Journal and the Financial Times raised a similar question about *Kodak*: why did it take *Kodak* so long to realize that the future of photography was digital? Now, more than a decade after digital photography took off, Kodak is finally, and desperately, trying to catch up, and announcing the layoffs of a significant proportion of its staff in the effort.

As Kodak President Antonio Perez said yesterday: "This is not rocket science. This is what you have to do for a business in decline." Kodak Chief Executive Daniel Carp said that the layoffs would allow the company to fund investments in its digital future. "It's just smart business in a business that's shrinking," Some observers would hesitate to use the word for "smart" for developments at Kodak: the phrase, "incredibly tardy," might perhaps come to mind.

Why do so many big, clever companies follow the same disaster course? Clayton Christensen in *The Innovator's Dilemma* (HBSP, 1997) has eloquently described the dynamic that almost guarantees that big companies will miss out on obvious innovations in their very field of expertise. Because they are market-leaders, the initial appearance of the new technology appears initially almost as a joke. Executives ask themselves: how could a low-quality digital camera possibly be an alternative to film in which Kodak has been the leader for more than a century? As the technology develops and starts to look serious, it then appears as a threat to the company's market dominance, rather than an opportunity. Executives within the company who try to launch initiatives to counter the threat aren't welcomed by the power structure which is locked into supporting its existing clientele with its existing technology: such initiatives typically have difficulty in getting funding and support, and often perish, along with the executives who promoted them. By the time the organization finally wakes up and realizes that its very future is in question, it is either too late and the company vanishes (e.g. *Digital Equipment Corporation*) or survives as a shadow of its former greatness (e.g. *A&P*).

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According to the WSJ's reporter, James Bandler, some companies have survived radical shifts in their core business. "*Intel* made a lucrative jump in the mid-1980s from the memory-chip business to microprocessors... *Xerox*, facing intensifying competition and a wrenching switch from analog to digital copier technology, survived a near-death experience in late 2000 and

managed to become competitive and profitable again by laying off thousands of workers, exiting unprofitable lines of business and outsourcing nearly all of its manufacturing."

But generally the story is a sad one. There are few happy endings.

The jury is still out on **Kodak**. The news hasn't been good for some time. Kodak employs about 21,000 workers in the Rochester area, many of whom are directly tied to the making, packaging and distribution of film and paper. Two decades ago, Kodak employed around 60,000 people in the area.

Yesterday's headline can be seen as an illustration of the continuing convulsions that Kodak is going through, with up to a fifth of its staff being cut in its efforts to catch up with digital technology. James Bandler writes that "as the film business shrinks, the company retools for the future". Yes, but so late! As Bandler notes, "Kodak invented popular photography for the U.S. with the launch in 1888 of the Kodak Camera, and came to dominate the business for much of the ensuing century. In recent years it has been aware of the digital threat and has built revenue in other areas, including health care, where it has a profitable digital-imaging business. ***But the company badly misjudged the speed with which digital photography would erode its core traditional business.***"

Eastman Kodak Co. now plans to cut its work force by as much as 21% by the end of 2006 and take charges of \$1.3 billion to \$1.7 billion, in a blueprint the company regards as a painful necessity for its transition to filmless digital imaging. The plan, which Kodak announced early Thursday, will eliminate from 12,000 to 15,000 jobs and result in annual operating-cost savings of \$800 million to \$1 billion by 2007, according to Kodak estimates. The company's business lines in film, where it is the world's No. 1 maker, and traditional photography have been shrinking rapidly during the past year. The company believes it needs a drastic overhaul to be a strong competitor in the digital arena, where

Some progress is already evident. According to market-research firm IDC, In the third quarter of 2003, Kodak was the No. 2 digital-camera shipper in the U.S., with a 17.5% share of units sold, ahead of Canon, Olympus Optical Co., Nikon Corp., Fuji Photo Film Co. and H-P. Sony Corp. had the No. 1 slot with a 22.4% share. Mr. Perez said Kodak's early data showed that it had the No. 1 position in the critical Christmas season.

But the digital market is a tough one. The Financial Times reports that Chinon, which Kodak partially owns, has recently been refocusing from digital cameras because of fierce price competition in favour of home security cameras.

The Kodak downsizing is another step by Mr. Carp, the CEO, in his campaign to make Kodak conform to the realities of a digital world. A career-long Kodak veteran, Mr. Carp has moved aside other veterans and surrounded himself with top executives hired from H-P, printer-maker Lexmark International Inc. and other companies with more digital expertise.

Why is the announcement being made now? Is the transformation real or not? According to Bandler, "the cutbacks seem also intended to reassure stockholders. The story being told by Kodak is one of tenacity: Kodak is willing to make the necessary sacrifices to vie with digital competitors such as Hewlett-Packard Co. and Canon Inc. Kodak holds its annual investors meeting in New York Thursday."

Thus Kodak announces the cuts in order to get Wall Street to accept its story that the transformation is real. The staff cuts are a sacrificial offering that are given to Wall Street as a symbol of its seriousness. Does Wall Street accept the offering and go along with the Kodak

AXD022605

story #37, organizational and business storytelling in the news daily update

Page 3 of 3

story? The initial news for the current Kodak management was temporarily encouraging (although less so for the staff being let go): on Thursday, the stock was up by 13% to its highest level in seven months.

The more important story for Kodak however is whether it can really turn itself into a digital powerhouse so that consumers actually buy its products to the extent reflected in its optimistic future storytelling of corporate turnaround and future profits. Time will tell.

As Bandler tactfully puts it, "questions remain about Kodak's ability to deliver on its promised transformation."

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Steve Denning consults and gives workshops and keynote presentations on topics that include: leadership, innovation, organizational storytelling, business storytelling, springboard storytelling, knowledge management, branding, marketing, values, communication, communities of practice, business performance, collective intelligence, tacit knowledge, business collaboration, knowledge, learning, community, performance improvement, visionary leadership, social potential, institutional community building, and internal communications. You can contact Steve at steve@stevedenning.com

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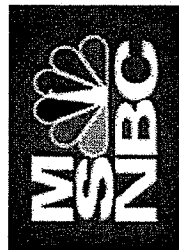
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Digital camera turns 30 — sort of

Kodak had prototype in 1975, but waited for decades to enter market

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By Ben Dobbin

AP Associated Press

Updated: 7:13 p.m. ET Sept. 9, 2005

ROCHESTER, N.Y. — Steven Sasson knew right away in December 1975 that his 8-pound, toaster-size contraption, which captured a black-and-white image on a digital cassette tape at a resolution of .01 megapixels, "was a little bit revolutionary."

When anyone asked, the Eastman Kodak Co. engineer ventured that it would become a commercial reality in 15 to 20 years.

It would be a quarter century, though, before Kodak began to capitalize on Sasson's breakthrough: the first digital camera.

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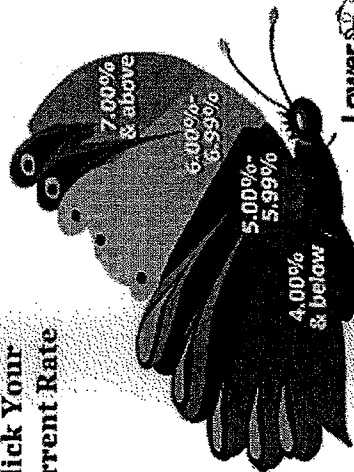
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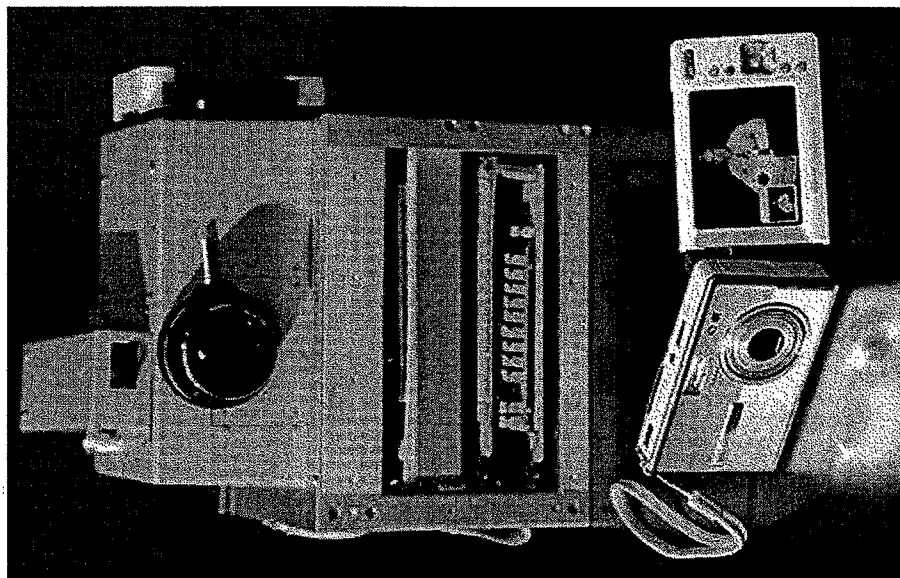
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In the meantime, the company that pioneered mass-market photography was busily amassing more than 1,000 digital-imaging patents. Today, almost all digital cameras rely on those inventions.

But Kodak's transition to a new world of photography was hindered by a reluctance to phase out celluloid film, its 20th-century gravity train.

Not until 2001 did Kodak begin selling mass-market digital cameras, though it leapfrogged Sony Corp. and Canon Inc. in 2004 for the lead in U.S. digital camera sales.

In the meantime, Sasson's fanciful alternative



David Duprey / AP

Kodak's prototype digital camera built in 1975 is shown next to Kodak's latest digital camera, the EasyShare One.

MSN TECH & GADGETS



Reviews: Which laptop is right for you?

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has gone from scientific curiosity to high-end novelty to America's most popular electronics gift, giving him unfamiliar star power late in his career and a few worries about his role in the steamroller effects of innovation.

After all, the toll of the digital-photography revolution on Kodak's work force "is enormous," he noted.

"Every once in a while," the garrulous, good-natured Sasson joked, "some of my friends say they're going to put my statue up at Kodak Park" — the mammoth but now rapidly shrinking film-manufacturing hub that George Eastman began erecting here in the late 1800s.

Sasson, now 55, never imagined as a relatively new Kodak hire in 1975 all the dazzling ingredients that have, in just a few years, put digital cameras in 50 percent of American households: fiber optics, the Internet, personal computers, home printers.

His invention began with a 30-second conversation.

Sasson, who'd recently earned a master's in electrical engineering, said his supervisor, Gareth Lloyd, gave him a "very broad assignment: He just said, 'Could we build a camera using solid-state imagers?'" — a new type of electronic sensor known as a charge coupled device, or CCD, that gathers optical information.

Finding the literature on digital imaging to be virtually blank — Texas Instruments Inc. had designed a filmless but analog-based electronic

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camera in 1972 — Sasson drew on whatever wizardry was available: an analog-to-digital converter adapted from Motorola Inc. components, a Kodak movie-camera lens and the tiny CCD chips introduced by Fairchild Semiconductor in 1973.

He set about constructing the digital circuitry from scratch, relying on oscilloscope measurements to guide him. There were no images to look at until the entire prototype was put together.

CONTINUED: 'A lot of curiosity, some annoyance'

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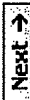


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